REMARKS

Claims 1-25, and 34-39 are pending for the Examiner's review and consideration. Of these claims, claims 1 and 22 are presently amended to more particularly define the claimed invention under 35 U.S.C. § 112, second paragraph, and new claims 36-39 have been added. Claim 19 has been cancelled without prejudice. Claims 26-33 have been withdrawn from consideration, and are presently also cancelled without prejudice. The right is reserved, however, to file divisional or other continuing applications directed to the cancelled claims or other disclosed but presently unclaimed inventions from the current application.

In the Office Action, claims 1-13, 15-24, and 34-35 were rejected under 35 U.S.C. § 103 as obvious over Cheng in view of in view of Canaperi. Claim 1 is directed to a method of preparing a semiconductor wafer, in which a composite structure is produced. The composite structure includes a matching substrate, a first layer of a first material grown thereon, and a second layer of a semiconductor material that is different from the first material grown on the first layer. This semiconductor material is grown in a relaxed state. A region of weakness is created in the matching substrate to facilitate splitting, and the first layer is removed from the second layer to remove damage and leave the surface of the second layer substantially smooth and with a substantially uniform thickness.

It is well known that creating a region of weakness typically forms a damaged region adjacent thereto (see page 12, lines 19-25 of the present application). This is also most often the case when atomic species are implanted into the wafer to provide the region of weakness, such as recited in claims 13 and 38.

Cheng implants hydrogen ions into a strained SiGe layer 808, specifically because the strain in that layer makes the layer weaker to improve crack propagation therethrough (Cheng 6:49-50). It is also well known that to provide a strained layer in which the strain is preserved, which is the case in Cheng since the properties of the strain are taught to be employed, the thickness of the strained layer must be very small. The typical thickness to retain the strain in these types of materials is commonly known to be around 200 ångstroms (see page 10, lines 19-23 of the application), and may even be around 40 ångstroms. On the other hand, the thickness of a region of damage is commonly known to be much greater than

that, typically around 1500 ångstroms. Thus, the implantation taught in Cheng would produce a region of damage that extends completely through layer 808 and well into the adjacent layer. Even if the strained layer were later removed, its removal would still not produce a surface on the second layer that is substantially smooth and of uniform thickness due to the damage therein, and the remaining surface of the second layer would likely not be usable in semiconductor manufacture due to the damage or would be of a very low quality.

As described in the present application, after the splitting at the region of weakness, a split wafer is typically treated to remove the remaining damaged layer that exists, such as due to the creation of the region of weakness and the splitting operation. The surface present following the split is not uniform, having elevated ridges and depressed valleys. Additional processes for smoothing this surface after splitting include polishing and etching, for instance, which while improving the condition of the surface, often do not result in the high level of smoothness and thickness uniformity by themselves that is possible with the claimed invention, as explained below. Consequently, removing the extremely thin remaining portion of the strained layer after splitting the Cheng wafer, would not leave the surface of the second layer with the claimed substantial smoothness and uniform thickness.

Canaperi does not teach any use of a strained layer. While Cheng teaches implantation in the strained layer to provide a particularly weak layer, Canaperi deposits hydrogen ions into a layer 30 that is provided on a graded layer 20. Thus, replacing the implantation of Cheng from the strained layer to outside the strained layer is specifically contrary to the teaching of Cheng with respect the relevant embodiment, since Cheng specifically intends to use the strain to increase weakness. Consequently, there is no motivation or suggestion to combine these two references, as the proposed combination would defeat the purpose of the relevant, Fig. 8, embodiment of Cheng.

By providing the region of weakness in the matching layer and splitting and then removing the material to the surface of the second layer, the present invention provides two different materials to remove that can protect the second layer, resulting in a highly improved quality of second layer. For example, a first etching or polishing step can be conducted to remove the remaining portion of the matching layer, and then another operation, such as another selective etching process can be conducted to remove the first layer.

On the other hand, when there is no extra layer between the layer that was split and the layer that is desired to be retained, such as in the references, the polishing or etching will likely remove a certain amount of material that is desired to be retained, retaining also some of the uneven features that were present in the surface of the split layer after the splitting. This is because, as mentioned above, the uneven surface after the splitting would include ridges of a greater thickness of material than in adjacent valleys, where the thickness of the remaining material is less. A polishing or etching step to remove this material will traditionally still result in a thicker amount material under the etched or polished ridge than under the etched or polished valley, since there is a greater amount of material to be removed under a ridge than under a valley. While the uniformity may be improved, a very large amount of material must be removed to provide a very smooth and uniform surface, if at all possible.

Under the present claim 1, the first layer provides a stop region for the removal of the remaining matching-layer material to improve the uniformity of the peaks and valleys, and when this first layer is removed, the boundaries between it and the second layer will further improve the quality of the second layer finish. Claim 36 defines that the smooth and uniform surface is substantially at the boundary between the first and second layers. Even if selective etching is used to remove the remaining portion of the layer in which the implanting and splitting has occurred, selective etching is seldom perfect, certainly in semiconductor materials as claimed, and etching can extend into the adjacent layer, which is desired to be protected, under the valleys of the uneven split surface. This is because the etching process will have to be continued after the valley material has already been removed to remove the material under the peaks. As a consequence, the final surface of the material to be preserved has remnants of the unevenness of the split surface after the etching.

Claim 1 provides the surprising advantage over the prior art, on the other hand, that while the removal of the remaining portion of the matching layer may still leave imperfections in the surface of the first layer, the removal of the first layer provides a further layer of protection for the second layer. Thus, two separate removal steps may be practiced, the first of which is selective to remove the remainder of the matching layer, and the second of which is selective to remove the remainder of the first layer. The resulting surface, such as at the surface between the second and first layer, is thus much smoother and of more uniform

thickness than provided in the prior art of record, while minimizing wasted material that needs to be removed.

Claims 2, 15, and 16 further define that the first layer is strained. It has been found that providing this stop layer in a strained state provides a very effective stop to the removal process that removes the matching layer, such as etching, and is easily selected for removal over the relaxed second-layer by a subsequent removal process. This is accomplished with very little material, and thus provides surprising advantage over the references. These claims are also believed to be patentable over Cheng and Canaperi.

Claim 17 defines that the remaining portion of the matching layer is removed after splitting, and claims 18 and 39 define that the first layer is removed by etching. Additionally, claim 37 defines that the remaining portion of the matching layer is also removed by etching. These claims are supported in the application, for example, at page 8, lines 7-13. As explained above, in this manner, the first layer can be used to decrease the amount of defects after the remaining portion of the matching layer is removed, such as by acting as an etch-stop layer, and the amount of defects are further reduced when this layer is removed by selective etching. The imperfect selectivity of the etching is thus significantly mitigated by the time that the etching reaches the surface of the second layer, at the boundary between it and the first layer. These claims also thus provide surprising advantages that are not suggested in Cheng or Canaperi, since neither of these patents provide an additional protective layer be etched away, and Cheng would actually result in significant damage to the layer adjacent the strained layer, countering efforts to smooth and produce a uniform surface remaining after any strained portion is removed.

Claims 23, 24, and 38 provide further details about the creation of the region of weakness, which further distinguish from Cheng, since the region of weakness is specifically defined as being provided at a sufficient depth to prevent damage thereby to the second layer, which is not possible in Cheng. These claims are thus also believed to be patentable over the references.

Claim 34 is directed to a method of preparing a semiconductor in which the composite structure is split, and the remaining portion of the first layer is thickened. This can serve to repair any damage to the first layer, and allows it to be used as an active layer in

subsequent chip manufacture. This is also not taught in either of the references of record, and claim 34 is also believed to be patentable thereover.

It is believed that the entire application is presently in condition for allowance. Should any issues remain, a personal or telephonic interview is respectfully requested to discuss the same in order to expedite the allowance of the application.

Respectfully submitted,

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Date

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